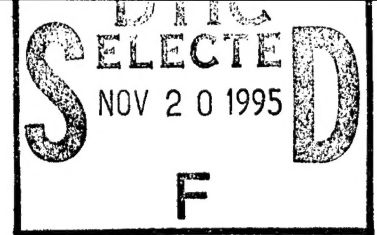




DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE CIVIL ENGINEER SUPPORT AGENCY



31 OCT 1995

FROM: HQ AFCEA/CES
139 Barnes Drive
Tyndall AFB FL 32403-5319

19951114 080

SUBJECT: **Engineering Technical Letter (ETL) 95-4: Mandatory Energy/Water Performance Standards for Replaced or Modified Equipment**

1. Purpose. This ETL establishes energy performance standards for replacing, upgrading, or modifying equipment. These standards are designed to achieve the maximum practicable improvements in energy efficiency, cost effectiveness, and water conservation.

2. Application. Requirements of this ETL are mandatory for all facilities equipment on Air Force installations.

2.1. Authority. This ETL incorporates the new requirements of the 1994 edition of 10 CFR 435 and the Energy Policy Act of 1992 (Public Law 102-486).

2.2. Effective Date: Immediately. Expires five years from date of issue.

3. Reference Publications.

3.1. 10 CFR 435, *Energy Conservation Performance Standards for New Buildings*, 1 January 1994 (refer to Attachments 3 through 6, this ETL).

3.2. ETL 94-5, *Fire Protection Engineering Criteria and Technical Guidance - Emergency Lighting and Marking of Exits*.

4. Specific Requirements. Replace, upgrade, or modify equipment in accordance with the following minimum requirements, as specified in 10 CFR 435.

4.1. Lighting.

4.1.1. Work Areas. For work areas larger than 450 ft², check lighting levels and set IAW Attachment 3, page 1. At least one lighting control must be used for each task or group of tasks within each 450 ft².

4.1.2. Individual Fluorescent Fixtures. Replacement 4-foot fluorescent fixtures must meet the following criteria:

- nominal lamp wattage <35 W
- minimum CRI = 69

DTIC QUALITY INSPECTED 8

APPROVED FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

- minimum average lamp efficacy = 75.0

T-8 32-watt electronic ballast systems are authorized, and tandem wiring is recommended where applicable. Do not use 40-watt fixtures as replacements. Avoid using incandescent lighting in office areas (use compact fluorescent lamps). Include all task lighting in calculations to determine proper lighting levels.

NOTE: Recommend using reflectors to reduce the number of tubes needed to achieve required light levels. U-shaped fluorescent tubes are not recommended due to their high cost and limited availability.

4.1.3. Exit Lights. Refer to ETL 94-5 for specific guidance.

4.1.3.1. Repair. Use retrofit kits containing LED lights ONLY.

4.1.3.2. Replacement. Do not use incandescent lighting for replacements. Use LED lights ONLY.

4.1.4. Exterior Lighting. Exterior lights must have photoelectric cells or attached timing devices. Refer to Attachment 3, sheet 3, for required lighting levels.

4.1.5. Fluorescent Lamp Ballasts. Fluorescent lamp ballasts must have a ballast efficacy factor not less than specified in Attachment 3, sheet 2. The power factor for these ballasts must be equal to or greater than 90 percent.

4.2. Motors. Motors will meet minimum efficiency standards IAW Attachment 4. Do not rewind motors except under emergency conditions. Replacement motors should achieve the highest efficiency and lowest energy consumption when meeting facility load requirements. Evaluate using motors with variable speed drives as replacements whenever possible.

NOTE: Recommend using *Motor Master*® computer software for a listing of manufacturers of motors suitable for normal operations. *Motor Master*® is included in the Construction Criteria Base (CCB).

4.3. HVAC Systems. Validate current HVAC system operation to determine proper loading and sizing of equipment for optimal use. Replacement equipment will meet minimum energy efficiency standards in Attachment 5.

4.4. Service Water Heating Systems. Water heaters and water storage tanks shall meet criteria in Attachment 6. Laboratories in public restrooms, except those for the disabled, shall be equipped with flow-limiting devices that limit maximum flow to either:

- 0.5 gpm;
- 0.75 gpm, if the device also limits the period of water discharge; or
- 2.5 gpm if equipped with a self-closing valve.

Maximum hot water discharge in showers used for other than safety reasons will be 2.75 gpm. Output temperature must not exceed 43° C (110° F).

4.5. Water Systems. Apply water system conservation measures in accordance with the following Corps of Engineers Guide Specifications (CEGS):

- CEGS 15400 for general purpose plumbing;
- CEGS 15405 for hospitals.

These guide specifications contain all current requirements to meet federal mandates and Executive Orders.

5. Point of Contact: Mr. Freddie L. Beason, HQ AFCESA/CESE, DSN 523-6361, commercial (904) 283-6361, FAX 523-6219.

William G. Schauz

William G. Schauz, Colonel, USAF
Director of Technical Support

6 Atch

1. Distribution List
2. ETL Index
3. Lighting Criteria
4. Motor Criteria
5. HVAC Criteria
6. Service Hot Water Criteria

Accession For	
NTIS CRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution /	
Availability Codes	
Dist	Avail and/or Special
A-1	

DISTRIBUTION LIST

DEPARTMENT OF DEFENSE

Defense Commissary Service Director of Facilities Bldg 8400 Lackland AFB TX 78236-5000	(1)	Defense Technical Information Center ATTN: DTIC-FDA Alexandria VA 22034-6145	(1)
AAFES/ATTN: CFE PO Box 660320 Dallas TX 75266-0320	(1)		

SPECIAL INTEREST ORGANIZATIONS

IHS (A.A. DeSimone) 1990 M Street NW, Suite 400 Washington DC 20036	(1)	Construction Criteria Database National Institute of Bldg Sciences 1201 L Street NW, Suite 400 Washington DC 20005	(1)
---	-----	---	-----

ENGINEERING TECHNICAL LETTERS (ETL)

SECTION A - CURRENT ETLs

ETL Number	Title	Date Issued
83-1	Design of Control Systems for HVAC Change No. 1 to ETL 83-1, U.S. Air Force Standardized Heating, Ventilating & Air Conditioning (HVAC) Control Systems	16 Feb 83 22 Jul 87
83-3	Interior Wiring Systems, AFM 88-15, Para 7-3	2 Mar 83
83-8	Use of Air-to-Air Unitary Heat Pumps	15 Sep 83
83-9	Insulation	14 Nov 83
84-7	MCP Energy Conservation Investment Program (ECIP)	13 Jun 84
86-4	Paints and Protective Coatings	12 May 86
86-5	Fuels Use Criteria for Air Force Construction	22 May 86
86-8	Aqueous Film Forming Foam Waste Discharge Retention and Disposal	4 Jun 86
86-9	Lodging Facility Design Guide	4 Jun 86
86-10	Antiterrorism Planning and Design Guidance	13 Jun 86
86-14	Solar Applications	15 Oct 86
86-16	Direct Digital Control Heating, Ventilation, and Air Conditioning Systems	9 Dec 86
87-1	Lead Ban Requirements of Drinking Water	15 Jan 87
87-2	Volatile Organic Compounds	4 Mar 87
87-9	Prewiring	21 Oct 87
88-2	Photovoltaic Applications	21 Jan 88
88-3	Design Standards for Critical Facilities	15 Jun 88
88-4	Reliability & Maintainability (R&M) Design Checklist	24 Jun 88
88-6	Heat Distribution Systems Outside of Buildings	1 Aug 88
88-9	Radon Reduction in New Facility Construction	7 Oct 88
88-10	Prewired Workstations Guide Specification	29 Dec 88
89-2	Standard Guidelines for Submission of Facility Operating and Maintenance Manuals	23 May 89
89-4	Systems Furniture Guide Specification	6 Jul 89
89-7	Design of Air Force Courtrooms	29 Sep 89
90-1	Built-Up Roof (BUR) Repair/Replacement Guide Specification	23 Jan 90
90-2	General Policy for Prewired Workstations and Systems Furniture	26 Jan 90
90-3	TEMPEST Protection for Facilities Change 1 Ref: HQ USAF/LEEDE Ltr dated 20 April 90, Same Subject	23 Mar 90

ENGINEERING TECHNICAL LETTERS (ETL)

SECTION A - CURRENT ETLs

ETL Number	Title	Date Issued
90-5	Fuel and Lube Oil Bulk Storage Capacity for Emergency Generators	26 Jul 90
90-6	Electrical System Grounding, Static Grounding and Lightning Protection	3 Oct 90
90-7	Air Force Interior Design Policy	12 Oct 90
90-8	Guide Specifications for Ethylene Propylene Diene Monomer (EPDM) Roofing	17 Oct 90
90-9	Fire Protection Engineering Criteria for Aircraft Maintenance, Servicing, and Storage Facilities	2 Nov 90
90-10	Commissioning of Heating, Ventilating, and Air Conditioning (HVAC) Systems Guide Specification	17 Oct 90
91-1	Fire Protection Engineering Criteria Testing Halon Fire Suppression Systems	2 Jan 91
91-2	High Altitude Electromagnetic Pulse (HEMP) Hardening in Facilities	4 Mar 91
91-4	Site Selection Criteria for Fire Protection Training Areas	14 Jun 91
91-6	Cathodic Protection	3 Jul 91
91-7	Chlorofluorocarbon (CFC) Limitation in Heating, Ventilating and Air-Conditioning (HVAC) Systems	21 Aug 91
93-1	Construction Signs	11 Mar 93
93-2	Dormitory Criteria for Humid Areas	13 Jul 93
93-3	Inventory, Screening, Prioritization, and Evaluation of Existing Buildings for Seismic Risk	18 Aug 93
93-4	Fire Protection Engineering Criteria - Automatic Sprinkler Systems in Military Family Housing (MFH)	11 Aug 93
93-5	Fire Protection Engineering Criteria - Electronic Equipment Installations	22 Dec 93
94-1	Standard Airfield Pavement Marking Schemes	5 Apr 94
94-2	Utility Meters in New and Renovated Facilities	10 Jun 94
94-3	Air Force Carpet Standard	10 Jun 94
94-4	Energy Usage Criteria for Facilities in the Military Construction Program	19 Aug 94
94-5	Fire Protection Engineering Criteria and Technical Guidance - Emergency Lighting and Marking of Exits	8 Nov 94

ENGINEERING TECHNICAL LETTERS (ETL)

SECTION A - CURRENT ETLs

ETL Number	Title	Date Issued
94-6	Fire Protection Engineering Criteria and Technical Guidance - Removal of Halogenated Agent Fire Suppression Systems	5 Dec 94
94-7	Affirmative Procurement Requirements for Construction and Other Civil Engineering Specifications	14 Dec 94
94-8	Design in Metric	14 Dec 94
94-9	Silicone Joint Sealants for Pavements	14 Dec 94
95-1	Halon 1301 Management Planning Guidance	12 May 95
95-2	Preparation Requirements and Management Plan (RAMP) Packages for Military Construction (MILCON) Program Projects	26 Oct 95
95-3	Planning Guide for Installation of Ultra-High-Molecular-Weight (UHMW) Polyethylene Panels Under Aircraft Arresting System Cables (CONUS Installations)	26 Oct 95
95-4	Mandatory Energy/Water Performance Standards for Replaced or Modified Equipment	31 Oct 95

ENGINEERING TECHNICAL LETTERS (ETL)

SECTION B - OBSOLETE ETLs

ETL Number	Date	Status
82-1	10 Nov 82	Superseded by ETLs 83-10, 86-1, 87-4
82-2	10 Nov 82	Superseded by AFEPPM 88-10
82-3	10 Nov 82	Superseded by ETLs 83-5, 84-2
82-4	10 Nov 82	Superseded by ETL 84-7
82-5	10 Nov 82	Superseded by ETLs 84-1, 86-13, 86-14
82-6	30 Dec 82	Cancelled
82-7	30 Nov 82	Cancelled
83-2	16 Feb 83	Superseded by ETL 84-3
83-4	3 Apr 83	Cancelled
83-5	5 May 83	Superseded by ETL 84-2
83-6	24 May 83	Cancelled
83-7	30 Aug 83	Cancelled
83-10	28 Nov 83	Superseded by ETL 86-1
84-1	18 Jan 84	Superseded by ETL 86-14
84-2	27 Mar 84	Superseded by ETL 94-4
84-3	21 Mar 84	Cancelled
84-4	10 Apr 84	Superseded by ETLs 86-7, 86-15, 87-5
84-5	7 May 84	Superseded by ETLs 84-8, 86-11, 86-18, 88-6
84-6	Not Issued	Cancelled/Not Used
84-8	19 Jun 84	Superseded by ETL 86-11
84-9	5 Jul 84	Superseded by ETL 88-7
84-10	1 Aug 84	Cancelled
88-5	2 Aug 88	Superseded by ETL 91-6
86-1	3 Feb 86	Superseded by ETL 87-7
86-2	5 Feb 86	Cancelled
86-3	21 Feb 86	Superseded by ETL 86-4
86-6	3 Jun 86	Superseded by ETLs 86-11, 86-18, 88-6
86-7	3 Jun 86	Superseded by ETL 86-15
86-11	3 Jul 86	Superseded by ETL 88-6
86-12	3 Jul 86	Superseded by ETL 90-2
86-13	18 Aug 86	Superseded by ETL 86-14
86-15	13 Nov 86	Superseded by ETL 87-5
86-17	17 Dec 86	Superseded by ETL 89-6
86-18	18 Dec 86	Superseded by ETL 88-6
87-3	12 Mar 87	Superseded by ETLs 87-6, ETL 88-5
87-4	13 Mar 87	Superseded by ETL 94-4
87-5	13 July 87	Superseded by ETL 94-2
87-6	21 Aug 87	Superseded by ETL-88-5
87-7	14 Oct 87	Superseded by ETL 89-1
87-8	19 Oct 87	Superseded by ETL 90-1

ENGINEERING TECHNICAL LETTERS (ETL)

SECTION B - OBSOLETE ETLs

ETL Number	Date	Status
88-1	5 Jan 88	Superseded by ETL 89-2
88-5	2 Aug 88	Superseded by ETL 91-6
88-7	24 Aug 88	Superseded by ETLs 90-3, 91-2
88-8	4 Oct 88	Superseded by ETL 91-7
89-1	6 Feb 89	Superseded by ETL 90-4
89-3	9 Jun 89	Superseded by ETL 93-5
89-5		Issued as ETL 90-7
89-6	7 Sep 89	Cancelled
90-4	24 May 90	Cancelled
91-8	24 Sep 91	Cancelled
91-3	14 Jun 91	Superseded by MIL HDBK 1008B, Jan 94
91-5	18 Jun 91	Superseded by ETL 94-5

CONSTRUCTION TECHNICAL LETTERS (CTL)

SECTION C - CURRENT CTLs

CTL Number	Title	Date Issued
88-2	DD Form 1354 Checklist	6 Jan 88
88-7	Constructibility Review Checklist	1 Nov 88
89-1	Thirty-Percent Design Submittal	10 Apr 89
89-2	MAJCOM Construction Management	30 May 89
89-3	Warranty and Guarantee Program	22 Sep 89
90-1	Management of the MILCON Planning and Execution Process	6 Mar 90
90-2	Definitions for Design Milestones	13 Mar 90

SECTION D - OBSOLETE CTLs

CTL Number	Status
87-1	Superseded by CTL 88-3
88-1	Superseded by CTL 90-1
88-3	Superseded by ETL
88-4	Replaced by Electronic Data File and Documentation in PDC/WIMS
88-5	Superseded by CTL 90-2
88-6	Issuance Cancelled

PRESCRIPTIVE UNIT LIGHTING POWER ALLOWANCE (ULPA), W/FT²

Building Type/Area Function	Gross Lighted Area Ranges (Ft ²)						Effective Date
	0 to 2000	2001 to 10,000	10,001 to 25,000	25,001 to 50,000	50,001 to 250,000	>250,000	
Food Service Fast Food/Cafeteria	1.50	1.38	1.34	1.32	1.31	1.30	1988
	0.92	0.85	0.82	0.81	0.81	0.80	1993
Leisure Dining Bar	2.20	1.91	1.71	1.56	1.46	1.40	1988
	1.60	1.56	1.52	1.48	1.44	1.40	1993
Offices	1.90	1.81	1.72	1.65	1.57	1.50	1988
	1.40	1.34	1.27	1.22	1.16	1.11	1993
Retail ¹ Retail General	3.30	3.08	2.83	2.50	2.28	2.10	1988
	2.70	2.52	2.32	2.05	1.87	1.72	1993
Mall Concourse Multi-Store Service	1.60	1.58	1.52	1.46	1.43	1.40	1988
	0.69	0.68	0.65	0.63	0.61	0.60	1993
Service Establishment	2.70	2.37	2.08	1.92	1.80	1.70	1988
	2.81	2.03	1.78	1.65	1.54	1.46	1993
Garages	0.30	0.28	0.24	0.22	0.21	0.20	1988
	0.25	0.24	0.23	0.22	0.21	0.20	1993
Schools Pre-Elementary	1.80	1.80	1.72	1.65	1.57	1.50	1988
	1.33	1.33	1.27	1.22	1.16	1.11	1993
Jr. High/High School	1.90	1.90	1.88	1.83	1.76	1.70	1988
	1.40	1.40	1.39	1.35	1.30	1.26	1993
Technical/Vocational	2.40	2.33	2.17	2.01	1.84	1.70	1988
	1.77	1.72	1.60	1.49	1.36	1.26	1993
Warehouse/Storage	0.80	0.66	0.56	0.48	0.43	0.40	1988
	0.60	0.50	0.42	0.36	0.32	0.30	1993

Notes:

1. Includes general, merchandising, and display lighting.

FLUORESCENT BALLAST FOR EFFICACY FACTORS*

No. of Lamps	Lamp Type	Nominal Operational Input Voltage	Design Starting Temperature (°F)	Input Frequency (Hz)	Minimum Ballast Efficacy Factor
1	4 ft rapid start	120 or 277	>40	60	1.805
2	4 ft rapid start	120	>40	60	1.060
2	4 ft rapid start	277	>40	60	1.050
2	8 ft slimline	120-277	>40	60	0.570
2	8 ft high output rapid start	120-277	<40	60	0.390

* For ballasts not specifically designed for use with dimming controls.

EXTERIOR LIGHTING UNIT POWER DENSITY

Area Description	Unit Power Density (UPD)
Exit (with or without canopy)	25 W/linear ft of door opening
Entrance (without canopy)	30 W/linear ft of door opening
Entrance (with canopy)	
High Traffic (retail, hotel, airport, theater)	10 W/ft ² of canopied area
Light Traffic (hospital, office, school)	4 W/ft ² of canopied area
Loading area	0.40 W/ft ²
Loading door	20 W/linear ft of door opening
Building Exterior Surfaces/Facades	0.25 W/ft ² of surface area to be illuminated
Storage and nonmanufacturing work area	0.20 W/ft ²
Other activity areas for casual use (picnic grounds, gardens, parks, and other landscaped areas	0.10 W/ft ²
Private driveways/walkways	0.10 W/ft ²
Public driveways/walkways	0.15 W/ft ²
Private parking lots	0.12 W/ft ²
Public parking lots	0.18 W/ft ²

**MINIMUM ACCEPTABLE
FULL-LOAD MOTOR EFFICIENCIES
FOR SINGLE SPEED POLYPHASE
MOTORS¹**

Horsepower	Minimum Rates Efficiency Percent
1 - 4	78.5
5 - 9	84.0
10 - 19	85.5
20 - 49	88.5
50 - 99	90.2
100 - 124	91.7
125 and above	92.4

¹ Motors operating more than 750 hours per year are likely to be cost-effective with efficiencies greater than those listed. The more efficient motors are classified by most manufacturers as "high-efficiency," and are presently available for common applications with typical nominal efficiencies of: 5 hp, 89.5%; 10 hp, 91.0%; 50 hp, 94.1%; 100 hp, 95.1%; 200 hp, 96.2%. Guidance for evaluating the cost effectiveness of high efficiency motor applications is given in NEMA MG 10-83 (name).

**STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE
UNITARY AIR CONDITIONERS AND HEAT PUMPS - AIR-COOLED, ELECTRICALLY
OPERATED
<135,000 BTU/H COOLING CAPACITY)
(EXCEPT PACKAGED TERMINAL AND ROOM AIR CONDITIONERS)**

Reference Standards ¹	Capacity (<135,000 Btu/h) [Mode]	Phases	Rating	Subcategory	Minimum Performance
ARI 240-81 ARI 210/ 240-89	<65,000 Btu/h [Cooling]	1	Seasonal ²	Split System	10.0 SEER
				Single-pkg	9.7 SEER
	<65,000 Btu/h [Cooling]	3	Standard ³	Split System & Single-pkg	9.5 EER
			Integrated Part- Load Valve ⁴	Split System & Single-pkg	8.5 IPLV
	≥65,000 Btu/h [Cooling]	All	Standard ³	---	8.9 EER
			Integrated Part- Load Valve ⁴	---	8.3 IPLV
	<65,000 Btu/h [Heating - Heat Pumps]	1	Seasonal ²	Split System & Single-pkg	6.6 HSPF
	<65,000 Btu/h [Heating]	3	High Temp ⁵	Split System & Single pkg	3.0 COP
			Low Temp ⁶	Split System & Single pkg	2.0 COP
	<65,000 Btu/h [Heating]	All	High Temp ⁵	Split System & Single pkg	3.0 COP
			Low Temp ⁶	Split System & Single pkg	2.0 COP

¹Use latest revision.

²To be consistent with National Appliance Energy Conservation Act of 1987 (P.L. 100-12)

³95 db

⁴80 db

⁵47db/43wb

⁶17db/15wb

Notes:

1. Ratings are based on outdoor temperatures (°F).
2. Definitions: COP = Coefficient of Performance
EER = Energy Efficiency Ratio
HSPF = Heating System Performance Factor
IPLV = Integrated Part Load Value
SEER = Seasonal Energy Efficiency Ratio

**STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE
UNITARY AIR CONDITIONERS AND HEAT PUMPS
EVAPORATIVELY-COOLED, ELECTRICALLY OPERATED, COOLING MODE
(<135,000 BTU/H COOLING CAPACITY)
(EXCEPT PACKAGED TERMINAL AND ROOM AIR CONDITIONERS)**

Reference Standards*	Capacity (<135,000 Btu/h)	Rating	Indoor Temp (°F)	Outdoor Temp (°F)	Minimum Performance
ARI 210/ 240-89 CTI 201(91)	<65,000 Btu/h	Standard	80 db/67 wb	95 db/75 wb	9.3 EER
		Integrated Part-Load Valve	---	80 db/67 wb	8.5 IPLV
	≥65,000 Btu/h	Standard	80 db/67 wb	95 db/75 wb	10.5 EER
		Integrated Part-Load Valve	---	80 db/67 wb	9.7 IPLV

*Use latest revision.

**STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE
WATER-COOLED AIR CONDITIONERS AND HEAT PUMPS
ELECTRICALLY OPERATED, COOLING MODE
(<135,000 BTU/H COOLING CAPACITY)**

Reference Standards*	Capacity (<135,000 Btu/h)	Rating	Indoor Temp	Entering Water (°F)	Minimum Performance
Water-Source Heat Pumps	<65,000 Btu/h	Standard	80 db/67 wb	85	9.3 EER
		Low Temp	80 db/67 wb	75	10.2 EER
ARI 320-93 CTI 201(91)	≥65,000 Btu/h	Standard	80 db/67 wb	85	10.5 EER
Groundwater-Cooled Heat Pumps ARI 325-93	(<135,000 Btu/h)	Standard	---	70	11.0 EER
		Low Temp	---	50	11.5 EER
Water-Cooled Unitary Air Conditioners ARI 210/240-89 CTI 201 (91)	<65,000 Btu/h	Standard	80 db/67 wb	85	9.3 EER
		Integrated Part-Load Valve	---	75	8.3 IPLV
	≥65,000 Btu/h	Standard	80 db/67 wb	85	10.5 EER

*Use latest revision.

**STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE
PACKAGED TERMINAL AIR CONDITIONERS AND HEAT PUMPS
AIR COOLED, ELECTRICALLY OPERATED**

Reference Standards ¹	Category/Mode	Rating (Outdoor Temps °F)	Minimum Performance (Btu/h = Capacity)
ARI 310-90	PTACs & PTAC HPs ² / Cooling	Standard (95 db)	10.0 - (0.16 * Btu/h ÷ 1000) EER
		Low Temp (82 db) ³	12.1 - (0.20 * Btu/h ÷ 1000) EER
ARI 310-90	PTAC HPs/Heating	Standard (47 db/43 wb)	2.7 COP

¹ Use latest revision.

² If the unit's capacity is less than 7000 Btu/h, use 7000 Btu/h in the calculation. If the unit's capacity is greater than 25,000 Btu/h, use 15,000 Btu/h in the calculation.

³ For multi-capacity equipment, the minimum performance shall apply to each capacity step provided and allowed by the controls.

**STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE
ROOM AIR CONDITIONERS AND ROOM AIR CONDITIONER HEAT PUMPS**

Reference ¹	Category	Capacity	Minimum Performance ²
ANSI/AHAM RAC-1-92	Without Reverse Cycle, With Louvered Sides	<6000 Btu/h	8.0 EER
		≥6000, <8000 Btu/h	8.5 EER
		≥8000, <14,000 Btu/h	9.0 EER
		≥14,000, <20,000 Btu/h	8.8 EER
		≥20,000 Btu/h	8.2 EER
	Without Reverse Cycle, Without Louvered Sides	<6000 Btu/h	8.0 EER
		≥6000, <20,000 Btu/h	8.5 EER
		≥20,000 Btu/h	8.0 EER
	With Reverse Cycle, With Louvered Sides	---	8.5 EER
	With Reverse Cycle, Without Louvered Sides	---	8.0 EER

¹ Use latest revision.

² Consistent with National Appliance Energy Conservation Act of 1987 (P.L. 100-12)

**STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE
WATER-SOURCE AND GROUNDWATER-SOURCE HEAT PUMPS
ELECTRICALLY OPERATED
(<135,000 BTU/H COOLING CAPACITY)**

Reference Standards ¹	Rating ²	Entering Water Temp ³ (°F)	Minimum Performance
Water-Source Heat Pumps ARI 320-86 CTI 201 (91)	Standard	70	3.8 COP
Groundwater-Source Heat Pumps ARI 325-85	High Temp	70	3.4 COP
	Low Temp	50	3.0 COP

¹ Use latest revision.

² Air entering indoor section 70 db/60 wb (maximum).

³ Water flow rate per manufacturer's specifications.

**STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE
LARGE UNITARY AIR CONDITIONERS AND HEAT PUMPS
ELECTRICALLY-OPERATED
(≥135,000 BTU/H COOLING CAPACITY)**

Reference Standards*	Category	Efficiency Rating	Minimum Performance
ARI 360-86	Air Conditioners, Air-Cooled	EER	N/A
		IPLV	7.5
ARI 360-86 CTI 201 (91)	Air Conditioners, Water/Evap.-Cooled	EER	9.6
		IPLV	9.0
ARI 340-86	Heat Pumps Air-Cooled/Cooling	EER	N/A
		IPLV	7.5
	Air-Cooled/Heating	COP (47 °F)	2.9
		COP (17 °F)	2.0
ARI 365-87	Condensing Units, Air-Cooled	EER	9.9
		IPLV	11.0
ARI 365-87 CTI 201 (91)	Condensing Units, Water/Evap.-Cooled	EER	12.9
		IPLV	12.9

*Use latest revision.

Notes:

1. For units that have a heating section, deduct 0.2 from all required EERs and IPLVs.
2. Condensing unit requirements are based on single-number ratings defined in paragraph 5.1.3.2 of ARI Standard 365-87.

**STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE
WATER-CHILLING PACKAGES
WATER- AND AIR-COOLED, ELECTRICALLY-OPERATED**

Reference Standards ¹	Category	Capacity (Tons)	Efficiency Rating	Minimum Performance
ARI 550-92 ARI 590-92 CTI 201 (91)	Water-Cooled	≥300	COP	5.2 ²
			IPLV	5.3 ²
		≥150, <300	COP	4.2
			IPLV	4.5
		<150	COP	3.8
			IPLV	3.9
	Air-Cooled, With Condenser	≥150	COP	2.5
			IPLV	2.5
		<150	COP	2.7
			IPLV	2.8
	Condenserless, Air-Cooled	All	COP	3.1
			IPLV	3.2

Note: The levels above are minimum performance levels. Better energy efficiencies may be available, and their use is encouraged.

¹ Use latest revision.

² Where R-22 or CFC refrigerants with equivalent ozone depletion factors are used, these requirements are reduced to 4.7 COP and 4.8 IPLV.

**STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE
BOILERS, GAS- AND OIL-FIRED**

Reference Standards ¹	Category	Capacity (Btuh)	Rating	Minimum Performance
DoE Test Procedure 10 CFR, Part 30, App N	Gas-Fired	<300,000	Seasonal	AFUE 80% ^{2,3}
	Oil-Fired	<300,000	Seasonal	AFUE 80% ²
AGA Z21.13-91 H.I. Htg. Boiler Std. 86 ASME PTC 4.1-64 U.I. 795-94	Gas-Fired	≤300,000	Max Rated Capacity, ⁴ Steady State	$E_C = 80\%$ ⁵
			Min Rated Capacity, ⁴ Steady-State	$E_C = 80\%$ ⁵
U.L. 726-90 H.I. Htg. Boiler Std. 86 ASME PTC 4.1-64	Oil-Fired	≥300,000	Max Rated Capacity, ⁴ Steady State	$E_C = 83\%$ ⁵
			Min Rated Capacity, ⁴ Steady State	$E_C = 83\%$ ⁵
H.I. Htg. Boiler Std. 86 ASME PTC 4.1-64	Oil Fired (Residual)	≥300,000	Max Rated Capacity, ⁴ Steady State	$E_C = 83\%$ ⁵
			Min Rated Capacity, ⁴ Steady State	$E_C = 83\%$ ⁵

¹ Use latest revision.

² Consistent with National Appliance Energy Conservation Act of 1987 (P.L. 100-12).

³ Except for gas-fired steam boilers for which minimum AFUE is 75%.

⁴ Provided and allowed by the controls.

⁵ E_C = combustion efficiency, 100% - flue losses.

**STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE
WARM-AIR FURNACES AND COMBINATION WARM-AIR FURNACES/AIR CONDITIONING UNITS**

Reference Standards ¹	Category	Capacity (Btu/h)	Rating	Minimum Performance
DoE Test Procedure 10 CFR, Part 30, App N	Gas-Fired	<225,000	Seasonal	AFUE 78% ^{2,3}
	Oil-Fired	<225,000	Seasonal	AFUE 78% ²
AGA Z21.47-93	Gas-Fired	≥225,000	Max. Rated Capacity, ⁴ Steady State	$E_t = 80\%$ ⁵
			Min. Rated Capacity, ⁴ Steady-State	$E_t = 78\%$ ⁵
U.L. 727-94	Oil-Fired	≥225,000	Max. Rated Capacity, ⁴ Steady State	$E_t = 81\%$ ⁵
			Min. Rated Capacity, ⁴ Steady State	$E_t = 81\%$ ⁵

¹ Use latest revision.

² Consistent with National Appliance Energy Conservation Act of 1987 (P.L. 100-12).

³ Minimum performance requirements for furnaces <45,000 Btu/h capacity are to be established by DoE under P.L. 100-12.

⁴ Provided and allowed by the controls.

⁵ E_t = thermal efficiency, 100% - flue losses.

WARM AIR DUCT FURNACES AND UNIT HEATERS			
Reference Standards ¹	Category	Rating	Minimum Performance
AGA Z83.9-90	Duct Furnaces, Gas-Fired	Max. Rated Capacity, ² Steady State	$E_t = 78\% ^3$
		Min. Rated Capacity, ² Steady-State	$E_t = 75\% ^3$
AGA Z83.8-90	Unit Heaters, Gas-Fired	Max. Rated Capacity, ² Steady State	$E_t = 78\% ^3$
		Min. Rated Capacity, ² Steady-State	$E_t = 75\% ^3$
U.L. 731-88	Unit Heaters, Oil-Fired	Max. Rated Capacity, ² Steady State	$E_t = 81\% ^3$
		Min. Rated Capacity, ² Steady State	$E_t = 78\% ^3$

¹ Use latest revision.

² Provided and allowed by the controls.

³ E_t = thermal efficiency, 100% - flue losses.

**STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE
OF WATER HEATING EQUIPMENT**

Type/Class	Fuel	Storage Capacity (Gal)	Input Rating	Applicable* Test Procedure	Minimum Performance		
					DoE Rating	Efficiency	Loss
Storage Water Heaters	Electric	≤ 120	≤ 12 kW	DoE; CFR Title 10, Part 430	$EF \geq 0.95 - 0.00132V$	—	—
		> 120 (or)	> 12 kW	ANSI C72.1	—	—	$SL < 1.9 \text{ W/ft}^2$
	Gas**	≤ 100	$\leq 75,000$ Btu/h	DoE; CFR Title 10, Part 430	$EF \geq 0.62 - 0.0019V$	—	—
		> 100 (or)	$> 75,000$ Btu/h	ANSI Z21.10.3-93; <i>Gas Water Heaters w/ Addenda Z21.10.3a</i>	—	$E_t 77\%$	$SL < 1.3 + 38/V$
	Oil	≤ 50	$\leq 75,000$ Btu/h $\leq 105,000$ Btu/h	DoE; CFR Title 10, Part 430 ↑ ↓	$EF \geq 0.59 - 0.0019V$	—	—
		> 50 (or)	$> 105,000$ Btu/h		$EF > 0.59 - 0.0019V$	—	—
Unfired Storage	—	All Volumes	All Inputs	—	—	—	$HL < 6.5 \text{ Btu/h/ft}^2$
Instantaneous	Gas**	—	All Inputs	ANSI Z21.10.3-93	—	$E_t 80\%$	—
	Distillate Oil	—	All Inputs		—	$E_c 83\%$	—
Pool Heaters	Gas**/Oil	—	All Inputs	ANSI Z21.56-91	—	$E_t 78\%$	—

* Use current test procedure.

** Natural gas or LPG.

Notes:

EF = Energy factor, overall heater efficiency by DoE test procedure.

E_t = Thermal efficiency with 70 °F, ΔT .

E_c = Combustion efficiency, 100% - flue loss when smoke = 0 (trace is permitted).

SL = Standby loss in W/ft² based on 80 °F, ΔT , or in %/hr based on nominal 90 °F, ΔT .

HL = Heat loss of tank surface area.

V = Storage volume in gallons.